ON

A NEW LESION

OBSERVED IN THE

BRAIN.

BY

JOHN BATTY TUKE, M.D.,
MEDICAL SUPERINTENDENT, FIFE AND KINROSS DISTRICT ASYLUM;

WILLIAM RUTHERFORD, M.D.,
TEACHER OF PRACTICAL PHYSIOLOGY IN THE UNIVERSITY OF EDINBURGH;

AND

CHARLES HOLLAND SKAE, M.D.,
ASSISTANT-PHYSICIAN, FIFE ASYLUM.

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OBSERVED IN THE

BRAIN OF AN INSANE PERSON.

For most of what we know regarding the pathologieal histology of the nervous system, we are indebted to the valuable observations of Rokitansky, Wedl, Virchow, Van der Kolk, Bennett, Lockhart Clarke, Leyden, Meschede, Rindfleisch, and Förster.

Although much has been done by these and other observers, it is nevertheless true that the pathologieal histology of the brain more especially is a vast field of inquiry which has as yet been but little cultivated. This, indeed, can hardly be wondered at, considering how short a period has elapsed since we—thanks to the fruitful labours of Lockhart Clarke—became acquainted with a mode in which nerve-tissue can be so prepared that thin sections can be made, and these rendered transparent without the delicate texture being destroyed, or the relative position of its parts disturbed.

Three years ago an inquiry into the minute structure of the brains of those who die insane was begun by Dr J. Batty Tuke; he was soon afterwards joined by Dr William Rutherford, and at a later period Dr Charles H. Skae was associated in the work.

In the following paper we intend giving only a few of the results of this investigation, reserving for further consideration and research a number of appearances, regarding the nature of which we have not yet come to a conclusion.

It may be as well to mention here that as yet only twenty brains of the insane, and two of the sane, have been examined by us. The former were not picked, but occurred consecutively; all of them were cases of various forms of chronic insanity. In each and all of these marked departures from the normal condition were observed. In the two brains of sane persons no lesions were detected.

We are very far from entertaining the hope that the microscope will in every case detect a cause for insanity, and we by no means

regard the lesions, one or more of which we have found in all the cases of insanity (chronic) yet examined by us, as the *cause* of mental aberration; on the contrary, there are many good reasons for believing that they are the *result* of long-continued perversion of brain-action; furthermore, it remains to be shown whether they are confined to the brains of such persons, and may not be found in the brains of those who die from long-continued exhausting and painful disease.

Finding it impracticable to examine every portion of any brain, we have, with a view to preserve uniformity, confined our attention almost exclusively to the following parts — the system of nomenclature adopted is the admirably simple one suggested by Professor Turner:—1. Superior middle and inferior frontal gyri; 2. Superior middle and inferior occipital gyri; 3. Convolutions on either side of the fissure of Rolando; 4. Corpora striata and thalami optici; 5. Portions of cerebellum; 6. Pons and medulla oblongata; 7. Any other portions of brain in which palpable lesions existed.

For the present we shall describe a lesion found by us in one of the cases.

In 1865 we first observed the following lesion, which, so far as we have been able to ascertain, has not hitherto been described. We have waited patiently for three years in the hope that we might find it in more cases than one; but though we have frequently met with appearances which on hasty observation might be regarded as identical with the lesion described in the sequel, we have not as yet found a second example of it. The case in which we observed it was that of a clergyman, James M., æt. 65. He had been well educated, and was an excellent preacher. Four years previous to admission to the Royal Asylum, Morningside, he suffered from an apoplectic seizure, which incapacitated him for duty during several months. He so far recovered that he was able to resume duty for a short period; but the supervention of symptoms of mental aberration, together with paraplegia, compelled its final abandonment. On admission, some indistinctness of speech and slight twisting of the face to one side was noticed. He spoke in a slow, mumbling manner. He was scarcely able to walk; when he attempted to do so his gait was staggering and unsteady. The unsteadiness of movement was confined to the lower limbs. He was frequently noisy and destructive, incoherent in his ideas, but had no distinct delusion.

About six weeks after admission he was seized with another apoplectic attack. During the two days following this seizure he lay in a semi-comatose condition, and it was observed that the temperature of the whole right half of the body was much lower than that of the left. He rallied from this attack, and at the end of a week was much in his usual state—with this exception, that he was no longer able to walk. His general health slowly failed.

Sudden and violent inflammation attacked his left eyeball, which resulted in its complete destruction. This complication gave him almost no pain. After this he gradually sank, and died two months after the apoplectic seizure.

Autopsy—seventy-three hours after death.—The arachnoid cavity contained six ounces of serous fluid. A clot was found lying between the dura mater and the parietal layer of the arachnoid over the right anterior lobe, extending from the falx cerebri to the base of the skull. The whole of the left hemisphere was covered with a clot, apparently more recent in its origin than that on the right side—it was in the arachnoid cavity. In the left middle fossa, close behind the foramen lacerum anterius, there was a ragged depression in the bone presenting a honeycomb appearance. The ophthalmic division of the 5th was carefully dissected on the left side, but no evidence of anything abnormal was found. Arteries at the base of the brain were dilated and atheromatous. A large cavity full of serous fluid was found in the left frontal lobe of the cerebrum. There was distinct evidence that the cavity was the result of apoplectic extravasation of old standing; it was of an irregular oval shape, about two inches long by an inch broad. The left half of the cerebellum was much atrophied.

Microscopical appearances.—Patches of gray degeneration were found around the wall of the apoplectic cyst and in the pons varolii, also crystals of hæmatoidine in the former situation. In the atrophied half of the cerebellum the pear-shaped cells of the outer gray layer were scarcely visible, while the white matter was greatly diminished in quantity. In the atrophied white matter there was a large number of *semi-opaque* whitish spots, which could easily be perceived with the naked eye in a thin section which had been hardened in chromic acid rendered transparent by turpentine, and coloured with carmine in the usual way. The spots were almost entirely confined to the white matter—only one could be seen in the gray, while in the former over a hundred could be counted in a single section with the naked eye.

The spots were irregularly scattered through the nervous tissue; in some parts they were closely grouped together, while in others there were hardly any. The majority of the spots were oval (fig. I.), some were round, while a few of the larger ones were lobulated, owing to the partial fusion of several smaller spots (fig. I., *a*, fig. II.). They were of all sizes, from 1-40th of an inch in diameter downwards. The long axis of the oval spots was generally found to lie parallel with the nerve-tubes surrounding them; sometimes, however, at right angles to these.

When viewed with a low magnifying power by direct light, the spots had a somewhat luminous pearly lustre. When magnified 250 and 800 diameters linear (figs. III. and IV.), they were seen to consist of molecular material, with a stroma of exceedingly

delicate colourless fibres (fig. IV.). In none of the spots could any nucleated oval or rounded masses of molecular matter be seen, such as are figured by Rindfleisch[1] as occurring in gray degeneration. With the appearance of these nucleated masses, numerous specimens in our possession have rendered us perfectly familiar.

Most of the spots had tolerably well-defined margins (figs. II., III., and IV.), consisting of nerve-tubes and bloodvessels curving round them, and looking as if they had been pushed aside by the molecular material. When the section was steeped in ammoniacal solution of carmine, the somewhat fibrous-looking walls of the spots became more deeply tinged than the nerve-tissue lying external. The molecular material of the spots did not, however, attract the colouring matter of the carmine. With a power magnifying 80 or 100 diameters linear, the majority of the spots appeared as if surrounded by red capsules. The molecular matter of which the spots consisted had a yellowish-green tinge, probably derived from the solution of chromic acid with which the tissue had been hardened. A few of the smaller spots were not, however, surrounded by distinct fibrous-looking walls, but the surrounding nerve-tissue appeared gradually to merge into the molecular material. Although many nerve-tubes curved partially round the spots, a solution in the continuity of others could be observed at the margins. The smallest spots visible were about 1-1500th of an inch in diameter; they were seen to consist of a somewhat diffuse molecular cloudiness or milkiness of the nerve-tissue. In very few of the spots could bloodvessels be seen lying amid the molecular material; they usually curved round the latter (fig. III., *b*), and at other times they were found lying amid the septa of a lobulated spot, but they did not appear to have any close relation to the molecular material. The nuclei of the capillaries and small arteries never appeared to have undergone any proliferation, nor could any multiplication of the nuclei of the neuroglia in the walls of the spots be detected.

When a section containing these spots was allowed to dry, the latter formed little eminences above the shrivelled nerve-tissue, and could easily be picked out from it with the point of a knife. They were not in the least degree gritty. Hydrochloric acid caused no effervescence. Acetic acid, boiling alcohol, and ether produced no alteration of the molecular material. When, however, strong pure nitric acid was added to a section containing the spots, the whole section, *molecular matter* as well as *nerve-tissue*, became more transparent. This was the more remarkable, seeing that spirit of turpentine, while it rendered transparent the nerve-tissue, did not affect the molecular matter. As the molecular material became transparent under the action of the nitric acid, a number of colourless rounded bodies, about the size of a blood-corpuscle, made their appearance in its midst (fig. V.). At first glance it

[1] Rindfleisch, Virchow's Archiv, Band xxvi. p. 474.

appeared as if the nitric acid had simply revealed these bodies, just as acetic acid reveals the nuclei of most cells by rendering the surrounding matter transparent; and the fact that these rounded bodies resembled the so-called amyloid bodies, favoured this notion; but when the action of the acid was carefully watched, these rounded bodies could be seen forming by the coalescence of minute transparent drops, apparently the molecular matter rendered fluid by the acid. After the acid had acted for five minutes or so, bubbles of peroxide of nitrogen began to be freely evolved from all parts of the nerve-tissue, and from the molecular matter of the spots as well. The successive shocks consequent on the evolution of the bubbles of gas rapidly brought about the coalescence of the drops inside the spots. When the covering glass was gently pressed upon, these globular bodies formed by the acid were seen to elongate, and from spots cut through at the edge of the section they could easily be squeezed out into the surrounding fluid, where they re-formed somewhat globular bodies (fig. v.). Many of them preserved their elongated form after the removal of the pressure; this showed that the matter of which they were composed was viscous. By repeated pressure on the covering glass and prolonged action of the acid, the viscous matter could be entirely removed from the spots, and nothing but the delicate fibrous stroma (fig. vi.) left behind. It was a network of very delicate connective tissue—the neuroglia, in fact, from which, however, the nuclei and nerve-tubes had disappeared. The disappearance of the nuclei and nerve-tubes could not have been due to the acid, for this did not cause them to disappear from the healthy tissue; the molecular material must therefore have replaced these two elements, leaving the connective tissue fibres intact. Around the spots so emptied of their molecular contents, the abrupt terminations of nerve-tubes could be distinctly seen, showing that a destruction of nerve element had taken place.

The molecular material, however, did not seem to be of a composition altogether differing from that of the nerve element; for though, unlike the latter, it was not rendered transparent by turpentine, nitric acid caused the appearance, from the nerve element, of viscous matter closely resembling, if not really identical with, that formed from the molecular material. This was particularly well seen in the gray matter of the cerebellum; under the action of the acid, colourless bodies could be seen to form which closely resembled the so-called amyloid bodies; when pressure was exerted upon them, they were seen to conduct themselves exactly like the viscous globules formed from the molecular material of the spots.

When dilute nitric acid (one part of acid to two parts of water) was used, the disappearance of the molecular matter was more rapid. In this case, however, the matter formed by the acid was not nearly so viscous; indeed, it formed quite fluid colourless drops, which, however, did not mix with the acid fluid, but floated about as detached globules.

Although the viscous matter produced by the nitric acid could be pressed so as to form permanently elongated bodies, these prolongations did not form spontaneously, as is the case when protagon (myeline) is placed in water or nitric acid. Strong sulphuric acid also rendered the nerve-tissue and the spots transparent, and brought about the conversion of the molecular matter into transparent viscous globules. Caustic potash had no effect; the absence of grittiness, and the fact that it did not effervesce on the addition of strong hydrochloric acid, was sufficient to show that the molecular matter was not calcareous. Nor did it seem to be of a fatty nature, as boiling ether did not dissolve it. Had it been protagon, it would have been soluble in boiling alcohol. Alkaline solution of iodine did not tinge the spots more than the surrounding nerve-tissue, and the farther addition of sulphuric acid did not produce a blue colour.

Let it be remembered, that the preceding account of the action of reagents applies to a tissue that had been steeped in alcohol, in a solution of chromic acid, and in an ammoniacal solution of carmine.

We did not recognise this lesion in the fresh state; we first saw it when thin sections had been made of the hardened tissue, so that we have not had an opportunity of examining it chemically in a pure and recent state, and cannot therefore pronounce an opinion as to its real chemical nature.

The most careful examination of the specimens of the lesion in our possession has not enabled us to come to a decided conclusion regarding the mode of development of these spots. The first stage seems to be the appearance of somewhat opaque, white, molecular material, which gives rise to a *cloudiness* of the tissue. We cannot, after the most careful examination, say what is the origin of this material. It does not seem to have any close relation to blood-vessels, for these, so far from being surrounded, are generally pushed aside by it. We have seen no evidence of any proliferation of the nuclei of the neuroglia or of the vascular walls. The molecular material, while it leaves the fibres of the connective tissue (neuroglia) intact, takes the place of its nuclei and of the nerve-tubes. The notion, however, that it is a mere *substitution* for these, and that the lesion is a mere *degeneration*, is opposed by the uniformly round or oval shape of the spots—their regular well-defined borders—the pushing aside of nerve-tubes and bloodvessels (figs. III. and IV.). These facts favour the notion that the molecular material is the result of active growth taking place either within itself, or in the tissue at its periphery. That active growth takes place in the latter would seem to be indicated by the deeper coloration with carmine of this, than of the nerve-tissue lying external. This deeper tint, though partially due to increased condensation of tissue, seems to be chiefly owing to the presence of a quantity of granular and molecular material which attracts the pigment. Perhaps this is a sort of germinal plasm; it is well to observe, however,

that most of the molecular material of the wall differs from that in the interior of the spot in this—that while the former is, the latter is not tinged by carmine: their chemical composition is therefore different. While we mention the deeper coloration by carmine of the walls of the spots than of the surrounding nerve-tissue as a fact in favour of the notion that vital activity is greater in the former than in the latter situation, we would not have it supposed that we consider the coloration of a tissue by an ammoniacal solution of carmine as an infallible test for the presence of a certain degree of vital or germinal power. There are, it is true, many facts which support such an idea, but there are not a few which show that implicit reliance upon it would lead to dangerous error. It may be well to remark that the curvature of nerve-tubes and bloodvessels partially round the spots may, to some extent, be accounted for by the greater shrinking of the nervous tissue than of the molecular material under the action of the hardening agent. This idea, however, cannot account for the appearance in more than a very slight degree.

In conclusion, then, we think that the facts we have described warrant us in putting forth the theory that this lesion is the result of a kind of growth which leads to the formation of molecular material, which, by encroachment, causes the disappearance of nerve-tissue. We would lay stress on the fact that this lesion differs from that which Rindfleisch has described (*l. c.*) as the essential change in gray degeneration. We repeat, that we have several specimens of this which show the nucleated masses of molecular plasma as figured and described by Rindfleisch; these cell-like bodies in an area of gray degeneration are, however, imbedded amongst well-marked fibrous septa, and the areas are not surrounded by the well-defined fibrous-looking walls which surround the spots which characterize the lesion described by us.

Regarding the development of the lesion in gray nervous matter, we cannot as yet pronounce an opinion: we saw only a single spot in the gray matter, and the section was at that part so thick that we could make nothing of it.

It may be that the lesion was the cause of the hemi-cerebellar atrophy—perhaps both, however, were due to the same cause. The left half of the cerebellum was atrophied, while it was the left frontal lobe of the cerebrum which contained the large apoplectic cyst. Is it possible that the trophic nerve-centre for the same side of the cerebellum was thereby implicated? The fact that the *left* eye was the seat of marked trophic change, shows that such an idea is by no means improbable.

It may be asked by some persons—Is this lesion not the result of the action of the agents employed to harden the brain? To this we answer, that we have subjected healthy brains to precisely the same treatment, and that other observers have done the same,

and no such appearances have been produced. Further, in the case described this lesion was found only in the white matter of the atrophied half of the cerebellum, although the half that was not atrophied was treated and examined in exactly the same way.

Explanation of Plate.

Fig. I.—Section of white matter of cerebellum containing white semi-opaque molecular spots of various sizes; some oval, others round. Most oval spots lie with their long axes parallel with the nerve-tubes. At *a*, a lobulated spot is seen.—× 15 diameters linear.

Fig. II.—Section of the same, containing a lobulated spot.—× 80 diam.

Fig. III.—Section of the same. *a′* and *a″* are milky opacities of the tissue, apparently an early stage in the development of the larger spots. An oval spot is seen at *b*, bounded on either side by a bloodvessel.—× 250 diam.

Fig. IV.—Section of the same. Two molecular spots and a portion of a third seen, with fibrous septa between them. Delicate fibres are seen amid the molecular material. —× 800 diam.

The above are copied from sections of the cerebellum rendered transparent by turpentine. In fig. I. the black spots represent colourless semi-opaque molecular matter. In figs. II., III., and IV. the dark margins of the spots represent tissue more deeply coloured with carmine than that which lies external to it.

Fig. V.—Section of the same, acted upon by strong nitric acid. A spot is seen in which there are a number of rounded bodies produced by the action of the acid on the molecular material. Some of these are elongated by pressure having been made on the section, and this has caused the expulsion of a quantity of viscous matter from the cavity of the spot into the surrounding fluid, where it has formed a number of bodies with a somewhat irregular rounded contour.

Fig. VI. shows the same portion of tissue acted on by the acid for a longer time, and submitted to repeated pressure. Nothing is now seen inside the spot but a stroma of very fine connective tissue. This section had not been rendered transparent by turpentine. —× 250 diam.

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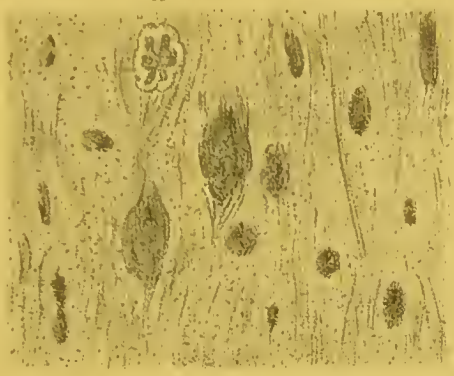
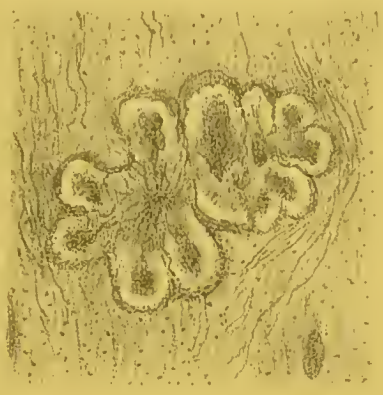
FIG. I.



× 15 Diam.

FIG. II.



× 80 Diam.

FIG. IV.

× 800 Diam.

FIG. V.

× 250 Diam.

FIG. III.

× 250 Diam.

FIG. VI.

× 250 Diam

W. H. M.c Farlane, Lith.r Edin.r